

BFi53ER0

Battery-Free Bluetooth Gateway

User Manual v3.6

Installation, the status light, the live view, the settings pages, receiving telegrams, Modbus TCP, RS-485, the terminals, time and history, backup, firmware updates and recovery.

Full part number: BFi53ER0-BF. For firmware 0.57.103 and later.

A BANFi Semiconductor Co., Ltd. product · protocol stack and firmware by FLSEMI

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Introduction

1.1 About this manual

This manual is for the people who install the BFi53ER0 Battery-Free Bluetooth Gateway, look after it on site, and take its telegrams into another system. It covers firmware 0.57.103; most screens were taken on 0.57.82, those of the RS-485 routes, the address change and the rules on 0.57.94, the rules toolbar on 0.57.97, the power-cut card on 0.57.99 and the sign-in page on 0.57.100. Every screen in it was captured from a gateway running that firmware.

The *Quick Start* and the *Hardware Specification* are published on the website; the Hardware Specification covers terminals, electrical ratings and mechanics. The JSON payload decoding and the complete Modbus register map are in the *System Integration Guide*, requested by leaving your company details at flsemi.us/downloads#guide. Names and addresses shown in the screenshots are examples.

In this manual, `bfi53er0-xxxx` stands for the gateway's own name, printed on its label.

1.2 What the gateway does

Full part number: BFi53ER0-BF. This manual describes the BFi53ER0 hardware running the Battery-Free Bluetooth Gateway firmware; give this part number when ordering, asking for a quotation or asking for support.

The gateway receives telegrams from battery-free, self-powered Bluetooth switches and sensors over Bluetooth LE and delivers them onto an Ethernet network, as UDP datagrams on IPv4, IPv6 or both. Any system can consume them: a building management system, a SCADA front end, a dashboard, or a script on a laptop.

It reports what it heard, how strongly, and whether anything from that device went missing. On UDP and TCP it passes the payload on as received; it holds none of the devices' keys, so authentication belongs with the receiving system. With a microSD card fitted, it also keeps a recording of the recent past, which a TCP client catches up from when it connects.

The same gateway is also a Modbus device. Over Modbus TCP it presents every switch and sensor it hears as registers, already decoded, beside its own state; on its RS-485 port it is a Modbus RTU gateway or a Modbus RTU device; and the BFi53ER0's terminals give four digital outputs, two digital inputs, two analog inputs and two analog outputs. A battery-free switch can work an output directly, with no PLC and no network in the path. With a card fitted, it keeps a history of the bus and the terminals as well.

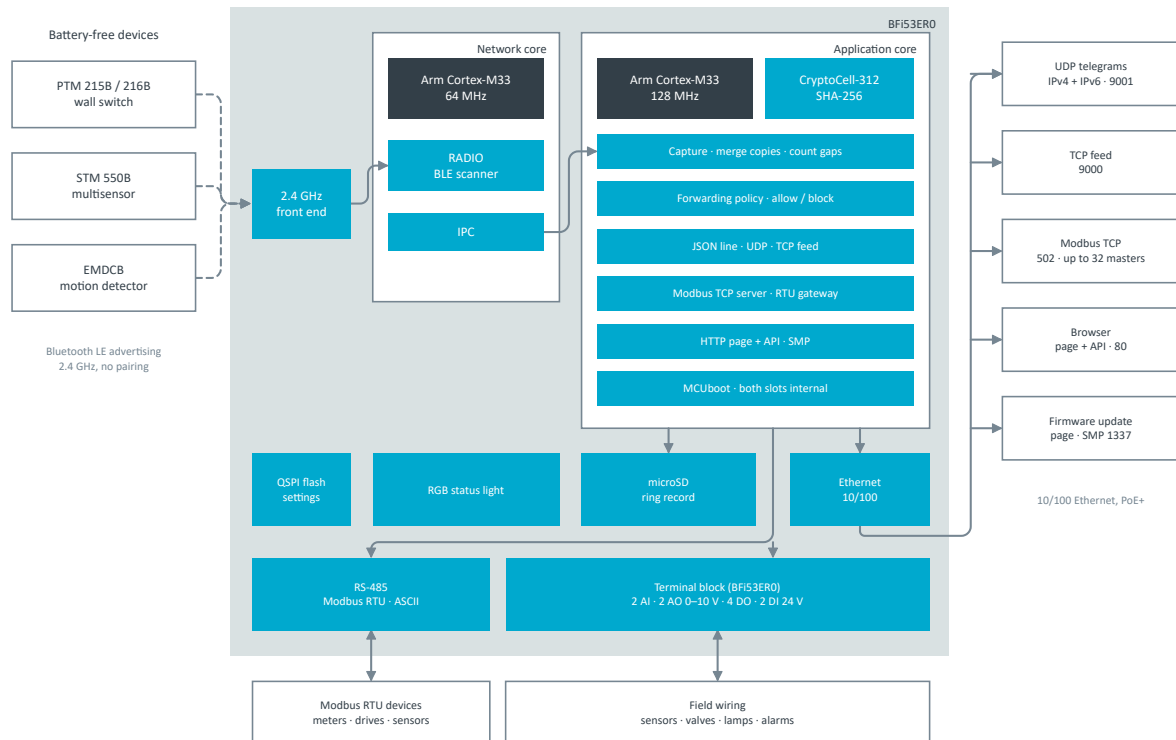


Figure 1: What the gateway connects

1.3 Models

Model	Difference
BFi53ER0	RS-485; four digital outputs and two digital inputs, 24 V, opto-isolated; two analog inputs and two analog outputs, 0–10 V
BFi53ER0S	adds a DECT NR+ radio; terminal assignment to be announced

Table 1: Models. Both run the Battery-Free Bluetooth Gateway firmware (ordering suffix -BF) described here

1.4 Before you start

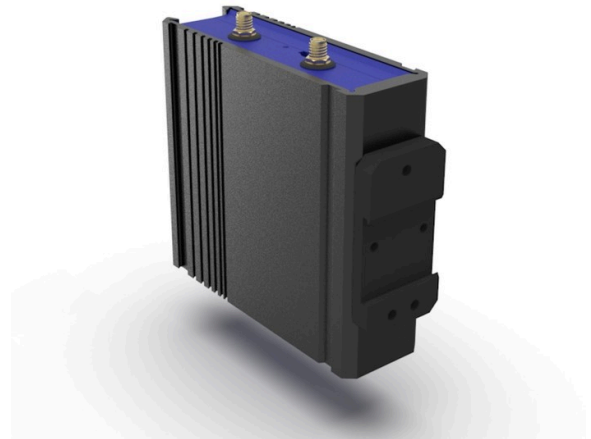
- **Power.** Power the gateway from a PoE+ port (IEEE 802.3at) or from a 14–32 V DC supply. A plain 802.3af port is not enough. Use only a Listed Class 2 power supply, or a Listed PoE switch or injector.
- **Indoors.** The enclosure has no ingress-protection rating. Outdoors or in wash-down areas, install it in a sealed cabinet with a bulkhead antenna connector.
- **Magenta means do not remove power.** While the status light shows magenta, alone or with white, firmware is being written (chapter 4).
- **Field wiring.** Wire the terminals with the power off. The terminal block is for Class 2 circuits only: DO-S1...S4 take Class 2 loads, such as 24 V relay coils and indicators, and mains is switched by a relay's contacts, never through the gateway's terminals. Ratings are in the *Hardware Specification*; the terminal names are on the case label and in chapter 11.
- **Change the password.** Every gateway leaves the factory with the password `admin`. The first sign-in makes you replace it before anything else.

The gateway

2.1 Enclosure



Terminal side: RJ-45, status light, terminals, SMA antenna



Rear: heat-sink body, DIN-rail / wall bracket

Renderings. The production enclosure is black-plated extruded aluminium.

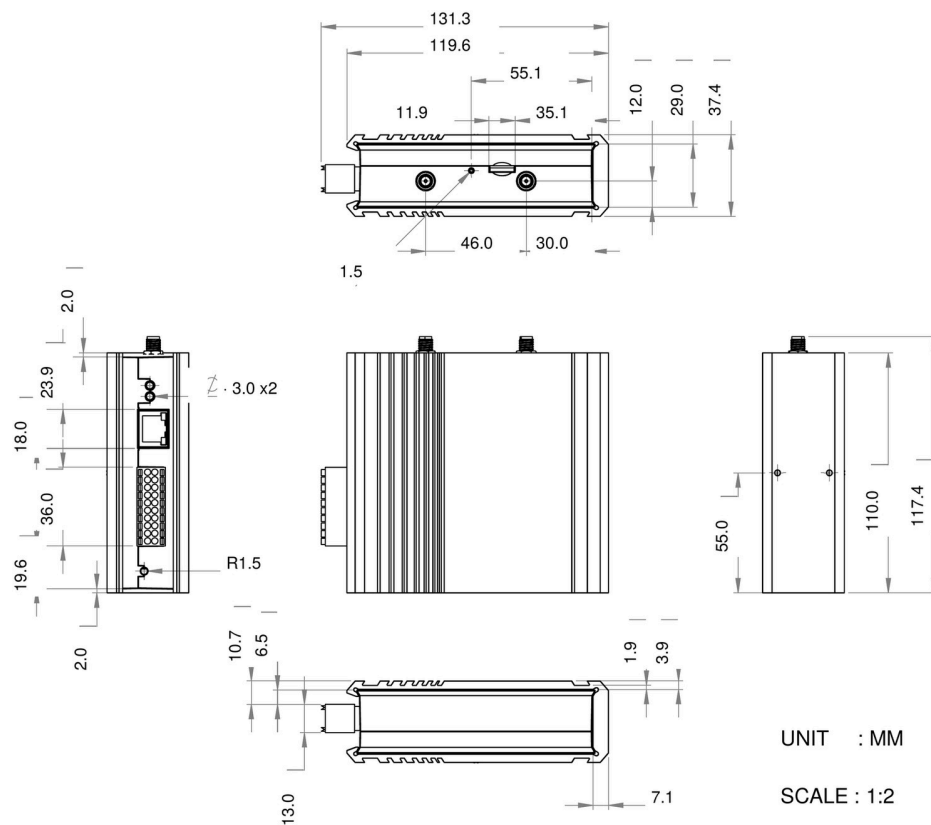


Figure 2: Outline dimensions, mm

2.2 Connectors and controls

Item	What it is for
SMA antenna connector	the 2.4 GHz Bluetooth antenna; screw it on before powering the gateway
RJ-45, 10/100 Ethernet	the network, and power by PoE+ (IEEE 802.3at, Type 2)
DC input terminals	14–32 V DC, 24 V typical, when PoE+ is not used
microSD socket	optional recording card; also takes firmware updates (chapter 15)
Reset button	beside the microSD socket: restarts the gateway; pressed 3 or 10 times it resets the password or all settings (chapter 16)
Status light	one RGB light; its colours are in chapter 4
I/O terminals	RS-485 (chapter 10); digital and analog inputs and outputs (chapter 11)

Table 2: Connectors and controls

2.3 Summary specifications

Radio	Bluetooth 5.3 LE receiver with a 2.4 GHz front end; external antenna on SMA
Processor	Nordic Semiconductor nRF5340 (BANFi BFi53MLG module), application core at 128 MHz
Ethernet	10/100 Base-T; IPv4 (DHCP, link-local or static) and IPv6 (link-local and router-advertised)
Power	PoE+ IEEE 802.3at Type 2, or 14–32 V DC
Storage	microSD, FAT or exFAT; settings kept in the module's flash
Devices	up to 256 battery-free devices tracked at once; up to 48 named, placed and listed
Delivery	UDP, one JSON object per datagram, IPv4 and IPv6; TCP feed on port 9000
Modbus	Modbus TCP server on IPv4 and IPv6, up to 32 masters at once; Modbus UDP and Modbus RTU over TCP
RS-485	Modbus RTU or ASCII, 1200 to 921600 bit/s; a gateway to the devices on the bus, or a device on it
Terminals	four digital outputs (open collector), two digital inputs (12/24 V DC), two analog inputs and two analog outputs (0–10 V)
Time	from a time server, a Modbus master or the browser; every start numbered
Web pages	live view without a password; settings with a password; local network only for settings
Mounting	DIN rail or wall; enclosure 119.6 × 110.0 × 37.4 mm body

Table 3: Summary

Installation

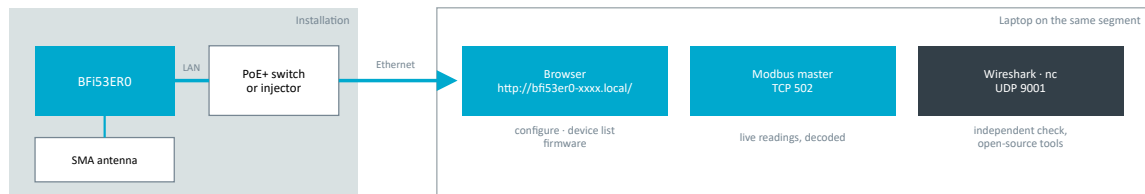


Figure 3: A first installation: gateway, PoE+ switch and a laptop on the same segment

3.1 What you need

Item	Notes
The gateway and its antenna	screw the antenna onto the SMA connector
A PoE+ switch port or injector	IEEE 802.3at, Listed; or a Listed Class 2 supply of 14–32 V DC and any Ethernet switch
A laptop on the same Ethernet segment	a direct cable through a PoE injector is enough: no DHCP server, router or internet is needed, because both ends give themselves link-local addresses
A browser	for the live view and the settings
A microSD card (optional)	FAT or exFAT; enables recording and card updates
Python 3 (optional)	for the example code, downloaded from the website (6.3)

Table 4: What you need

3.2 Mounting and the antenna

Mount the gateway on a DIN rail or a wall, with the antenna upright and clear of metal cabinets and cable trays. Put it where the switches and sensors are, not where the network cable happens to end: each telegram reports its signal strength (`rssi`), and the live view shows it, so a site walk with a switch in hand shows quickly whether a position works.

3.3 The microSD card

A card is optional. With one, the gateway records every telegram, whether or not anyone is listening, in a ring of files that never fills the card. A TCP client that connects later is sent what it missed. Without one, everything else works, and the status light breathes amber instead of blue.

- Use a FAT- or exFAT-formatted card. The gateway never formats a card: one it cannot read is left as it is.
- Fit or change the card with the power off, or restart the gateway afterwards. A card pulled while running stops the recording until the next start; nothing else is affected.
- The card can also carry a firmware update (15.4) and receives the update results.

- With a card, the gateway also keeps a history of the RS-485 registers it polls, the terminals and its own events (12.2).

3.4 First start

Step	Do	You should see
1	Screw on the antenna, then connect Ethernet from the PoE+ port	the status light shows red, green, blue and white in turn, then white while starting, then breathes blue (with a card) or amber (without)
2	On the laptop, open <code>http://bfi53er0-xxxx.local/</code>	the live view; a card appears for each device as it reports
3	Press a battery-free switch near the gateway	the status light flashes green; the switch appears, with the contact pressed lit
4	Press <i>Settings</i> and sign in with <code>admin</code>	you are asked for a new password first, then the settings
5	Optional: capture UDP port 9001 in Wireshark	one JSON datagram per telegram, on IPv4 and on IPv6

Table 5: First start

Nothing needs configuring at either end. By default the gateway sends to link-local multicast and broadcast, so anything on the segment that listens on UDP port 9001 receives the telegrams.

Status light

The status light breathes one colour for the state of the gateway, most urgent first. After start-up the states are checked in the order of the table, and the first that applies is shown. Over any state it flashes green for 0.2 s on every telegram heard, so an installer pressing a switch sees at once whether the gateway received it.

Colour	Breath	Meaning
white	1.2 s	starting
magenta	0.7 s	firmware being written — do not remove power
magenta / white, fast	0.25 s each	firmware being written from the microSD card at start — do not remove power
green, fast	0.5 s	for 15 s: password (3 presses) or all settings (10 presses) reset with the reset button
magenta / white, slow	1 s each	the image from the microSD card is on trial; it keeps itself after 2 minutes — do not remove power
red	3 s	no network address
blue, fast	1 s	Bluetooth open for a firmware update
amber	3 s	capturing; the microSD recorder is off (no card, or the card failed)
cyan	4 s	capturing and recording, and a TCP feed client is connected
blue	4 s	capturing and recording
green flash	0.2 s, once	a telegram was heard

Table 6: Status light

- **At power-up** the light first shows red, green, blue and white, 1.2 s each: a check, from across the room, that each colour works. It is skipped when the light is switched off, and cut short when an update from the card starts.
- **Brightness** is set from 0 to 100 %, or off, under *System* (7.9). The update colours are always shown, at no less than 25 %, even when the light is switched off.

On the network

5.1 Addresses and the name

	How the gateway gets it
Name	bfi53er0-xxxx.local, the name on the label; computers on the same network find the gateway by it
IPv4	DHCP, with an automatic link-local address while no DHCP server answers; or a static address (7.3)
IPv6	always a link-local address; a global address by router advertisement where a router offers one. Nothing to set

Table 7: Addressing

When the gateway's address changes, it keeps answering to its name, so the page keeps opening by name. The name works on the gateway's own network segment; from another subnet, use its address. The name can be changed on the *Network* page; either reset (chapter 16) brings back the one on the label.

5.2 Finding the gateway

Open <http://bfi53er0-xxxx.local/>, with the name printed on the gateway's label. Windows 10 and 11, macOS and Linux find .local names on their own network segment. If the name does not open, use the address the DHCP server gave the gateway, as listed by the router or the DHCP server.

5.3 What the network must allow

Traffic	Direction	Port	Needed for
UDP telegrams	out	9001 (configurable)	the telegram stream
TCP feed	in	9000	optional stream clients; local network only
HTTP	in	80	live view; settings and API (local network only)
SMP over UDP	in	1337	firmware update from a computer; local network only
Modbus TCP	in	502	when Modbus TCP is on (chapter 9); local network only
Modbus UDP, RTU over TCP	in	502 UDP, 4001 TCP	when turned on (9.3); local network only
SNTP	out	123	the time, when a time server is set (12.1)
DHCPv4	out / in	67 / 68	an IPv4 lease, when DHCP is used
ICMPv6, NDP, RA	both	—	IPv6 addressing

Table 8: Traffic, from the gateway's side

- The default destinations, `ff02::1` and `255.255.255.255`, stay on the local segment. A collector on another subnet or VLAN needs a unicast destination (7.4).
- The receiving computer's firewall must accept inbound UDP on the port. This is the most common reason a correctly set-up gateway seems to send nothing.
- Switches with IGMP or MLD snooping may hold back multicast; a unicast destination avoids the question.

Live view

6.1 The page

Open <http://bfi53er0-xxxx.local/>. No password is needed.



Figure 4: Live view, desktop browser

There is one card per device, in address order, so a device stays in the same place.

- **Switches** light the contact pressed — A0, A1, B0 or B1, or a single KEY — from press to release, and at least 0.25 s, so a quick tap is still seen. The last one used keeps an outline.
- **Sensors** show their readings: occupancy, contact, temperature, humidity, illuminance, acceleration and energy store.
- **Every card** also shows the name, place, coordinates and height entered on the *Devices* page, with a map link, the signal strength, the sequence number and any telegrams missed.

The gateway pushes each telegram to the page the moment it is heard, so the page follows a rocker as it is pressed and let go. Up to four pages are updated this way at once; a fifth falls back to asking four times a second.

Clear empties the page until devices are heard again, and restarts the count of missed telegrams. When forwarding is switched off, the page says *display only*.

6.2 On a phone

The page fits a phone's width: the cards stack in one column.

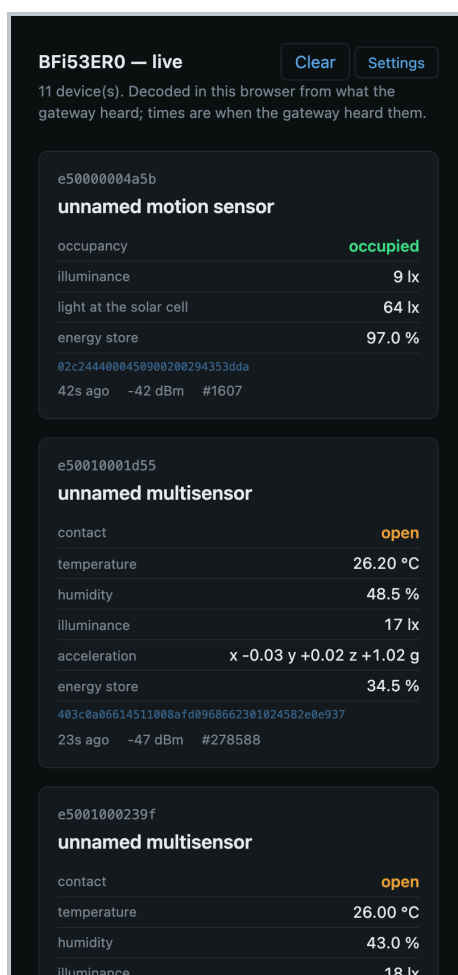


Figure 5: Live view on a phone, 400 px wide (top of the page)

6.3 Example code

Three small programs, downloaded from the website, show the gateway's data on a computer with nothing but Python 3: `udp_receive.py` prints every telegram received over UDP (8.1), `tcp_feed.py`

reads the TCP feed with its catch-up (8.2), and `modbus_identify.py` makes a first Modbus TCP read (chapter 9).

```
python3 udp_receive.py
python3 tcp_feed.py bfi53er0-xxxx.local
python3 modbus_identify.py bfi53er0-xxxx.local
```

They are a starting point for your own software, which may use and change them freely to integrate with BFi53ER0 products.

Settings pages

The settings are at `http://bfi53er0-xxxx.local/admin`. The bar across the top shows the product, the gateway's name, the firmware version and the gateway's state, with *Live view* and *Sign out*. Below it is a menu of ten pages. *I/O* and *RS-485* are described in chapters 11 and 10, and the Modbus TCP card on *Forwarding* in chapter 9. Each page is named in the address (for example `/admin#devices`), so a reload or a bookmark returns to it.

Local network only. The settings pages, the sign-in and every settings call answer only the local network: link-local and unique-local IPv6, the private and link-local IPv4 ranges, and loopback. A request from any other address is refused and counted.

7.1 Signing in

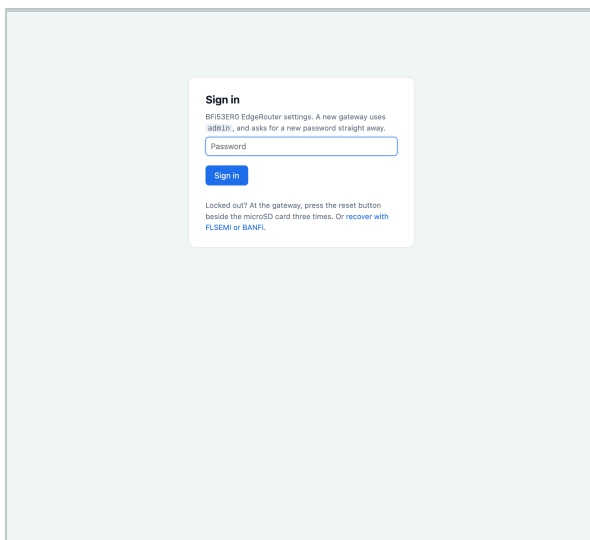


Figure 6: Sign-in

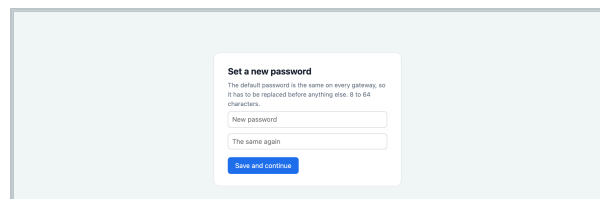


Figure 7: First sign-in: a new password is required

	Behaviour
Default password	admin, the same on every gateway, so the first sign-in must replace it before anything else
New password	8 to 64 characters, not admin; stored as a salted, iterated hash, never as itself
Session	kept in the browser tab; ends after 30 idle minutes, or with <i>Sign out</i>
Wrong passwords	five in a row lock the sign-in for 30 s, doubling each time up to 15 minutes
Locked out	press the reset button three times, or use <i>Recover with FLSEMI or BANFi</i> (chapter 16)

Table 9: Sign-in

After a firmware update the gateway restarts and an open page asks for the password again. Once you sign in, the page reloads itself, so that it always matches the firmware it talks to.

7.2 Overview

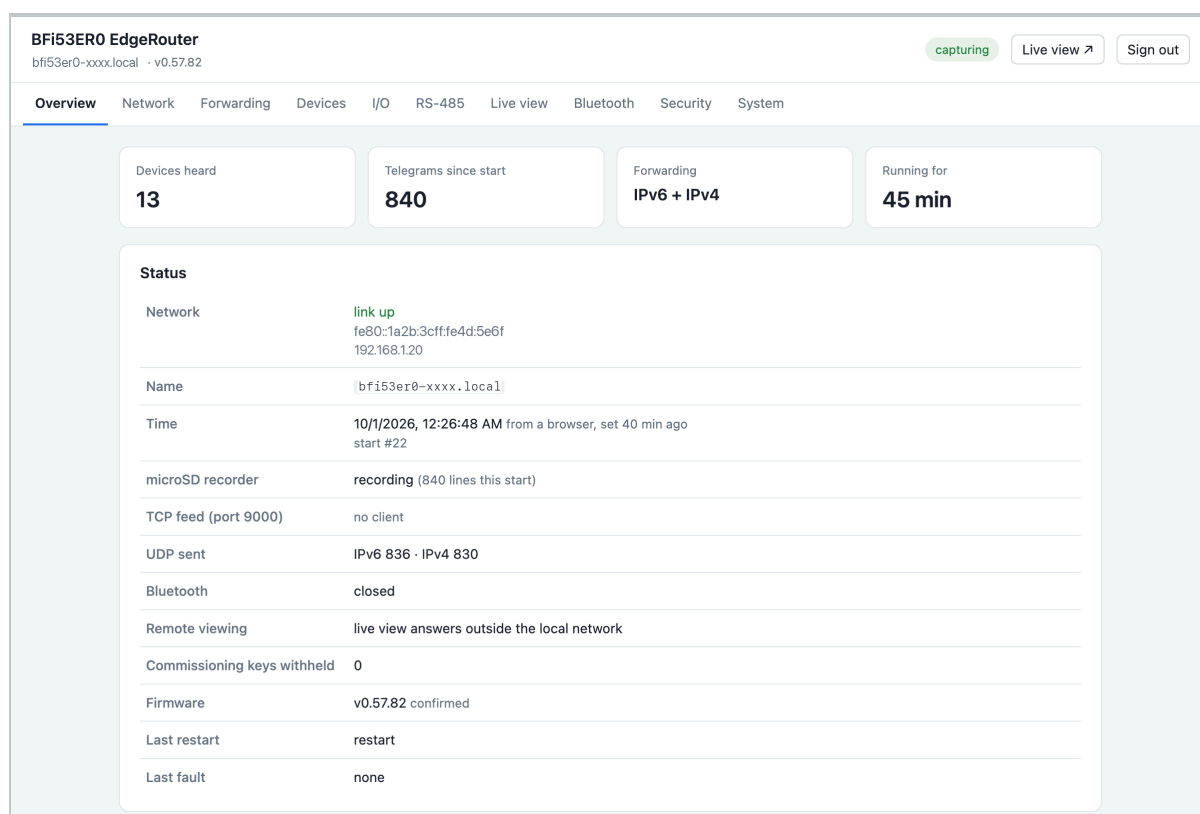


Figure 8: Overview

The state of the gateway on one page: devices heard, telegrams since the start, what is forwarded, and how long it has been running. Below that: the network and its addresses, the name, the time and the start number, the microSD recorder, TCP feed clients, UDP datagrams sent per family, Bluetooth, remote viewing, commissioning keys withheld, the firmware, and the cause of the last restart and the last fault. A firmware or a network setting on trial is shown as a banner on every page, with its *Keep* or *Confirm* button.

7.3 Network

Figure 9: Network

- **Name.** The name the gateway answers to: letters, digits and –, up to 32 characters. It takes effect at once, and the page moves to the new name.
- **IPv4 mode.** *DHCP, falling back to link-local* (the default), or *static* with address, prefix length and gateway.
- **IPv6** is automatic; the page shows the addresses in use.

Applied on trial. A change that could cut the page off is applied on trial. Reload the page over the new address and confirm within 120 s, or the gateway puts the previous settings back by itself.

7.4 Forwarding

The screenshot shows the 'Forwarding' settings page. At the top, there's a section 'Forward telegrams' with a checked checkbox 'send them on over the network' and a note: 'On. Off, telegrams still appear on the live view and are still recorded to the microSD card; nothing leaves the gateway.' Below this, there are two columns for 'IPv6' and 'IPv4'. For IPv6, 'Send telegrams' is checked 'on', 'Destination' is 'ff02::1', and 'UDP port' is '9001'. For IPv4, 'Send telegrams' is checked 'on', 'Destination' is '255.255.255.255', and 'UDP port' is '9001'. Below these, 'Sent so far' shows '842' for IPv6 and '836 (6 failed)' for IPv4. A note explains the defaults: 'ff02::1' and '255.255.255.255', port 9001 — every computer on this segment receives them. A unicast address reaches one computer, also across routers. With both on, each telegram goes out once per family. The TCP feed on port 9000 follows the same device list. There's a dropdown 'Which devices to forward' set to 'every source that is heard' with a note 'Mark devices on the [Devices](#) tab.' At the bottom, 'Installation details' has an unchecked checkbox 'attach name and position to every telegram' and a 'Save' button.

Figure 10: Forwarding

Setting	Default	Options
Forward telegrams	on	off: display only. Telegrams still appear on the live view and are still recorded; nothing is sent
IPv6: on, destination, port	on, ff02::1, 9001	any IPv6 unicast or multicast address; any port
IPv4: on, destination, port	on, 255.255.255.255, 9001	any IPv4 unicast or broadcast address; any port
Which devices to forward	every source that is heard	an allow list or a block list, marked on the <i>Devices</i> page
Installation details	off	add the device's name, place, latitude, longitude and height to every telegram

Table 10: Forwarding

Choice	Sent	A device heard for the first time
every source that is heard	all	sent
allow list	only devices marked <i>allowed</i>	not sent until allowed
block list	all except devices marked <i>blocked</i>	sent

Table 11: Which devices are forwarded

The two lists are kept separately, so switching between them loses neither.

A receiver on Wi-Fi needs a unicast destination. An access point sends broadcast and multicast onto the air without acknowledgement or retry, and drops them when busy. Measured with a laptop on an access point's Wi-Fi: broadcast arrived about 67 % of the time and multicast about 80 %; with the laptop's own address as destination, every telegram arrived. Set the family's destination to the receiver's address, or use the TCP feed (8.2).

7.5 Devices

Devices

Every source that is heard is sent on. No list is in use; choose an allow list or a block list on the [Forwarding](#) tab to pick devices.

Anything heard is listed here, unnamed and on neither list. The gateway hears an address; the rest is yours to fill in.

Slot	Address	Name	Place	Latitude	Longitude	Height (m)	
0	e500100253d			0.000000	0.000000	0.00	x
1	e500100244d			0.000000	0.000000	0.00	x
2	e50010001d55			0.000000	0.000000	0.00	x
3	e5001002659			0.000000	0.000000	0.00	x
4	e50010027f5			0.000000	0.000000	0.00	x
5	e5001002efc			0.000000	0.000000	0.00	x
6	e5001002550			0.000000	0.000000	0.00	x
7	e500100239f			0.000000	0.000000	0.00	x
8	e5001002fa8			0.000000	0.000000	0.00	x
9	e5001002efb			0.000000	0.000000	0.00	x
10	e5000004a5b			0.000000	0.000000	0.00	x
11	e21500054adb			0.000000	0.000000	0.00	x
12	e21500054ab6			0.000000	0.000000	0.00	x
13	e21500092da6			0.000000	0.000000	0.00	x
14	e21500093578			0.000000	0.000000	0.00	x
15	e2150009357a			0.000000	0.000000	0.00	x
16	e21500092d95			0.000000	0.000000	0.00	x

Latitude and **longitude** say where on the earth the device is, in decimal degrees: north and east are positive, south and west negative. The easy way to get them is a map: in Google Maps, right-click the spot and the first line of the menu is the two numbers, latitude first — for example 25.033000, 121.565400.

Height is metres above sea level. It is the one that tells floors apart: the ground there, plus about 3.5 m for each floor up, is close enough. Leave all three at 0 if position does not matter to whoever receives the telegrams.

Figure 11: Devices

Every device heard is listed by its address, so installation is a matter of filling in boxes. **x** takes a device off the list; one still in range comes back, unnamed, when next heard. When a list is in force, each device also has a tick for *allowed* or *blocked*.

Field	Meaning
name, place	free text, UTF-8, up to 27 and 39 bytes
latitude, longitude	decimal degrees, north and east positive. In Google Maps, right-click the spot: the first line of the menu is the two numbers, latitude first
height (m)	metres above sea level; the ground there plus about 3.5 m per floor is close enough
all three 0	position not given

Table 12: Device fields

7.6 Live view settings

Live view heading

Heading

The heading of the live page at /. Empty for the default. Device names and places shown there are the ones on the [Devices](#) tab; a device without a name shows as an unnamed switch, multisensor or motion sensor.

Remote viewing

From outside ☒ allow the live view (/) from outside the local network

Since the start 0 live-view request(s) answered from outside; 0 refused

Read-only: device names, places and coordinates shown on the live view can be seen by anyone who reaches the gateway. This page, the sign-in, firmware update and the TCP/UDP feeds answer the local network only, whatever this says. Being reachable from the internet also takes your router: a forwarded port 80, or a global IPv6 address the firewall lets through.

Figure 12: Live view settings and remote viewing

- **Heading.** The title of the live view, up to 48 bytes; empty for the default.
- **Remote viewing.** Whether the live view also answers outside the local network. On by default. It opens the live view only, read-only: the settings, the sign-in, firmware update and the TCP and UDP feeds answer the local network only, whatever it says. Anyone who can reach the gateway then sees the device names, places and coordinates. Being reachable from the internet also takes the site's router: port 80 forwarded, or a global IPv6 address that its firewall lets through.

7.7 Bluetooth

Bluetooth

Closed: the gateway only listens for EnOcean and cannot be connected to.
 Open it to update the firmware over Bluetooth, for example with nRF Device Manager (number of buffers: Disabled; mode: Test only; keep the new version on the System tab afterwards). No pairing: only images signed for this product run.

Figure 13: Bluetooth

At start the radio only listens: nothing can connect to it. This page opens Bluetooth for 10 minutes, for a firmware update from a phone (15.3); the status light breathes blue quickly while it is open. There is no pairing, because only images signed for this product run, however they arrive.

7.8 Security

Password

New password

8 to 64 characters. Other signed-in sessions are signed out.

[Change password](#)

Sign-in

This page and the sign-in answer the local network only. Five wrong passwords lock the sign-in for 30 s, doubling each time up to 15 min.

Forgotten password

At the gateway: press the reset button beside the microSD card three times (press, wait for the light to turn white, press again). Remotely: the *Recover with FLSEMI* link on the sign-in page.

[Sign out](#)

Figure 14: Security

Change the password here. Other sessions are signed out. The ways back in when the password is lost are in chapter 16.

7.9 System

Firmware

Running	v0.57.82 confirmed
Other slot	v0.57.82
Next restart	this image again
Last restart	restart

Update No file chosen [Upload and restart](#)

The signed application image, up to 480 KiB. The gateway restarts by itself and runs the new image on trial; reload this page and keep it. If it never comes back, the old image returns at the next restart.

[Go back to v0.57.82](#)

Figure 15: System: Firmware

The *System* page has seven cards:

- **Firmware.** The running version and whether it is kept, what is in the other slot, what the next restart will do, and the cause of the last restart. *Upload and restart* installs a new image (15.1).
- **Time and History on the microSD card.** Where the time comes from, and what is recorded on the card (chapter 12).
- **Update from the microSD card.** Whether a newer image found on the card is installed at start, and the result of the last attempt (15.4).
- **Status light.** Brightness from 0 to 100 %, or off, with the legend of chapter 4.
- **Settings backup.** Save every setting to a file, or restore from one (chapter 14).
- **Maintenance.** *Reset network settings* and *Reset to factory defaults* (chapter 16).

Receiving telegrams

8.1 UDP

Every telegram is sent as one UDP datagram carrying one JSON object. A receiver binds the port; there is no subscription, handshake or acknowledgement. Two telegrams as received, from a motion detector and from a multisensor:

```
{"src":"e50000004a5b","at":1,"seq":1540,"d":"02b2449800451c0020024fc3bcac","rssi":-38,"copies":0,"gaps":0,"up":166448}
{"src":"e50010002659","at":1,"seq":1469675,"d":"402c0b06754562008afb5d576623010279ae7a3dae","rssi":-63,"copies":0,"gaps":9,"up":8767937}
```

Field	Meaning
src	the device's Bluetooth address, 12 hex digits
seq	the device's sequence counter; with <code>src</code> it identifies a telegram
d	the payload as hex, including the device's signature, undecoded
rssi	signal strength, dBm
copies	further copies of the telegram heard on other channels: link margin
gaps	telegrams from this device never heard, cumulative
up	milliseconds since the gateway started; a telegram carries no time of day
key_withheld	present on a commissioning telegram: the device's key was replaced by zeros

Table 13: Telegram fields

- With both families on, a dual-stack receiver gets each telegram twice, once per family. `src` and `seq` together tell the copies apart.
- The receiver stamps each telegram with its own clock; the gateway sends no time of day.
- A rising `gaps` means telegrams from that device were never heard.
- Where every event matters, read the TCP feed or the card recording as well: UDP can be lost on the network too.

From a shell, with `socat`:

```
socat -u UDP6-RECV:9001,reuseaddr - # IPv6 (and IPv4-mapped)
socat -u UDP4-RECV:9001,reuseaddr - # IPv4 only
nc -6 bfi53er0-xxxx.local 9000 # TCP feed, one line per telegram
```

8.2 TCP feed

The same JSON objects, one per line, to up to four clients connected to TCP port 9000, on the local network only. With a card fitted, a client that connects is first sent the telegrams recorded since the last one any client received, then the live stream, in order. A client must read what it is sent: one that does

not take a line within 2 s is disconnected, and gets what it missed when it connects again. The feed follows the same allow or block list as UDP.

```
nc bfi53er0-xxxx.local 9000
```

8.3 Checking with standard tools

No BANFi software is needed to see that the gateway works. In Wireshark, capture udp port 9001 and decode it as JSON (*Analyze* → *Decode As...*). From a terminal:

```
tshark -i en0 -f "udp port 9001" -d udp.port==9001,json -T fields -e json.member_wit  
h_value
```

```
$ sudo tcpdump -i en0 -n -q udp port 9001
23:17:04.832548 IP 192.168.1.20.39957 > 255.255.255.255.9001: UDP, length 135
23:17:04.832550 IP6 fe80::1a2b:3cff:fe4d:5e6f.49392 > ff02::1.9001: UDP, length 135
```

Not `nc -u -l`. It prints the first datagram and then nothing: it connects its socket to the first sender, and later datagrams to the broadcast or multicast address no longer match it. Use `tshark`, `tcpdump`, `socat`, `udp_receive.py`, or a unicast destination.

8.4 Commissioning keys

A switch or sensor put into commissioning mode broadcasts its own AES-128 key in the clear, so that a system can learn it over the air. The gateway replaces those 16 bytes with zeros before the telegram goes anywhere — UDP, the TCP feed, the card, the live view — and marks the telegram "key_withheld":1. A system that needs the key reads it from the device label (QR code or NFC).

Modbus TCP

A PLC, a SCADA system or a building management system reads the gateway over Modbus TCP: every device it hears, already decoded, its terminals and its own state. With permission, a master also sets the outputs and changes settings. Modbus TCP is off until it is turned on.

9.1 Turning it on

Modbus TCP

Server

☒ answer Modbus TCP on port 502

over IPv6 and IPv4

☒ allow a master to set the outputs: digital outputs, analog outputs, input counters (I/O tab)

☒ allow a master to change settings: allow and block lists, taking devices off the list, names, places, positions, the forwarding switches, and the I/O settings

Save

Every device on the Devices tab, decoded: switch presses, temperature, humidity, light, occupancy, contact, battery and the rest, with the radio figures. The gateway is at input register 0; the device in slot n (the Slot column) at input and holding register $1000 + 100 \times n$. Modbus has no password: it answers the local network only, and with writes off it cannot change anything.

Also

☐ Modbus UDP on port 502

☐ Modbus RTU over TCP on port 4001

The same registers and the same RS-485 routes, for SCADA drivers that use them: UDP carries the Modbus TCP request and answer in one datagram each; RTU over TCP carries the serial frame itself (address, PDU, CRC) over a TCP connection, as a serial device server does. Both follow the switch, the IP choice and the write permissions above, answer the local network only, and share the 32 places for masters with Modbus TCP.

Who may ask

1.

address or address/prefix

read only

2.

address or address/prefix

read only

3.

address or address/prefix

read only

4.

address or address/prefix

read only

5.

address or address/prefix

read only

6.

address or address/prefix

read only

7.

address or address/prefix

read only

8.

address or address/prefix

read only

Save the list

this computer: 192.168.1.10/32

Empty: any address on the local network, as before. With any line filled: **only** the addresses listed, the first line that matches decides — for Modbus TCP, UDP and RTU over TCP alike (not this page). Examples: 192.168.1.20, 192.168.1.0/24, fe80::12:3:4, fd00::/8. **Read only**: reads, here and through the RS-485 bus; any write, and any function other than a read on the bus, is refused (0x01). **Read and write**: as the switches above allow. A master no longer listed is dropped at once. List your SCADA first.

Since the start

0 master(s) connected now; 12028 request(s), 1 exception(s), 89 write(s), 1 write(s) refused; 0 connection attempt(s) from outside the local network dropped

Figure 16: Forwarding: the Modbus TCP card

Setting	Default	Options
Answer Modbus TCP on port 502	off	over IPv6 and IPv4, IPv4 only or IPv6 only. Off closes the port
Allow a master to set the outputs	off	digital outputs, analog outputs and the input counters (chapter 11)
Allow a master to change settings	off	allow and block lists, taking devices off the list, names, places, positions, the forwarding switches, the I/O and RS-485 settings, the poll list and the time
Also: Modbus UDP on port 502	off	9.3
Also: Modbus RTU over TCP	off, port 4001	9.3
Who may ask	empty: any address on the local network	up to eight addresses or prefixes, each read only or read and write (9.4)

Table 14: Modbus TCP settings

Modbus has no password. It answers the local network only, and with both write ticks off a master can read but change nothing: a write is answered with exception 01.

9.2 What a master finds

Unit ID 255 (or 0) is the gateway itself. While the RS-485 port is a gateway, the other unit IDs go to the devices on the bus (chapter 10); while it is off, every unit ID is the gateway.

Registers	What they hold
input 0–29	the gateway: map version, firmware version, time running, telegrams, devices on the list, masters connected, requests served, the time and its source, the start number
input 100–163	the terminals: digital inputs and outputs, edge counters, analog inputs in mV, μ A and scaled, their alarm flags, the analog outputs, the supply
input 200–379	the RS-485 port: its settings, counters, the devices answering, the cache, and the state of each poll
input $1000 + 100 \times n$	the device in slot n (the <i>Slot</i> column on the <i>Devices</i> page): status, address, sequence number, signal strength, telegrams missed; for a switch the contacts held and presses per contact; for a sensor each value, with a bit saying whether it is valid
holding 0–6	forwarding switches and policy; Modbus UDP and RTU over TCP
holding 100–169	the outputs (digital bits, analog mV) and the terminal settings
holding 200–229, 300–379	the RS-485 settings and the poll list
holding 400–401	the time, in Unix seconds (12.1)
holding $1000 + 100 \times n$	the device in slot n : allowed, blocked, take off the list, latitude, longitude, height, name, place
coils 0–3, discrete inputs	the digital outputs; the digital inputs, the outputs as they are, the safe state and the analog-input flags

Table 15: The register map in outline

- Function codes 01–06, 15, 16 and 43/14 (device identification: vendor, product code BFi53ER0–BF, firmware version).
- A master that can only use function 03 can read the input registers too.

Word order, text packing, every field with its units and limits, the exceptions and worked examples are in the *System Integration Guide*, requested by leaving your company details at flsemi.us/downloads#guide.

9.3 Modbus UDP and Modbus RTU over TCP

Some SCADA drivers use one of these instead of Modbus TCP. Both reach the same registers and the same RS-485 routes, and both follow the same write ticks and the same list of addresses.

- **Modbus UDP**, port 502: the Modbus TCP request and answer, in one datagram each. Requests for the RS-485 bus have four places; a fifth at the same time is answered with exception 06.
- **Modbus RTU over TCP**, port 4001 by default: the serial frame itself (address, PDU, CRC) over a TCP connection, as a serial device server does. These connections share the 32 places of Modbus TCP.

9.4 Who may ask

With the list empty, any address on the local network may ask. With any line filled, only the addresses listed may, for Modbus TCP, UDP and RTU over TCP alike; the first line that matches decides.

Level	A master at that address may
read only	read, here and through the RS-485 bus. Any write, and any function other than a read sent on to the bus, is refused (exception 01)
read and write	read and write, as the two ticks allow

Table 16: Address list levels

Write an address (192.168.1.20, fe80::1:2:3:4) or a prefix (192.168.1.0/24, fd00::/8). The page shows *this computer*, the address it is seen from, so that the list can start with it. A master no longer listed is disconnected at once. List the SCADA system first. The list is set on this page only, not over Modbus.

9.5 How much it carries

	Measured on a bench gateway
Masters at once	32 (Modbus TCP and RTU over TCP together)
Requests	about 400 per second, shared evenly among the masters
A read answered by the gateway	a few milliseconds
During a firmware update	the gateway keeps answering: the longest pause measured was 23 ms over the network, 36 ms from the settings page and 118 ms over Bluetooth

Table 17: Capacity

Since the start, at the foot of the card, counts the masters connected now, the requests, the exceptions, the writes, the writes refused and the connections refused from outside the local network.

RS-485 Modbus RTU

The gateway has one two-wire RS-485 port: terminals 02 RS485(+), 04 RS485(–) and 06 RS485-GND. The bus is terminated at the gateway's end. The *RS-485* page sets what the port is.

The port is	What happens
off (the default)	the port is unused; every Modbus TCP unit ID is the gateway
a gateway	the gateway is the bus master: Modbus TCP masters reach the devices on the bus through it, by unit ID
a device	the gateway is a device on the bus: a PLC or HMI on the bus reads and writes this gateway at its own address

Table 18: RS-485 roles

10.1 The port and the line

RS-485 Modbus RTU

The port is a gateway: Modbus TCP masters reach the devices on the bus

Gateway (master): the routes below send unit IDs to the devices on the bus; unit 0 and unit 255 stay this gateway. **Device (slave):** a PLC or HMI on the bus reads this gateway at the address below — the same registers as over Modbus TCP, under the same write permissions ([Forwarding](#) tab), whether Modbus TCP is on or not; address 0 is a broadcast, carried out and never answered. **Off:** every Modbus TCP unit ID is this gateway, as before.

Address on the bus 1 1–247, device mode

Every device on one bus needs its own address. Before changing it, check that no other device on the bus uses the new one: two devices answering at once garble each other's answers, and the master sees bad frames from both. The address takes effect when saved; the serial master must then use it.

Line 9600 baud 8 data bits no parity 1 stop bit

framing Modbus RTU ASCII is most often 7 data bits, even parity, 1 stop bit; 7 bits with no parity needs 2 stop bits.

As set on the devices. Terminals 02 RS485(+), 04 RS485(–), 06 RS485-GND; the bus is terminated at this end.

Timing answer within 1000 ms 1 retry 0 ms extra between requests

A device that fails 3 times in a row (0: never) is answered for with 0x0B at once, and tried again every 10 s.

This gateway's unit ID 255 and 0: answered here, not forwarded

Routes

unit	1	to	247	→ address = unit +	0
unit	0	to	0	→ address = unit +	0
unit	0	to	0	→ address = unit +	0
unit	0	to	0	→ address = unit +	0

Unit IDs in a range go to RTU address unit + offset (1–247). 0 in the first box: route unused. The default sends 1–247 to the same address.

Exceptions

- ☒ 0x0A when no route matches
- ☒ 0x0B when the device does not answer
- ☒ 0x06 when the queue is full

Unticked: no answer, and the master times out by itself — some masters prefer that.

Save

Figure 17: RS-485: the port, the line, timing, routes and exceptions

Setting	Default	Options
Address on the bus	1	1–247, device mode. Check that no other device on the bus uses it
Line	9600 bit/s, 8 data bits, no parity, 1 stop bit	1200 to 921600 bit/s; even, odd or no parity; 1 or 2 stop bits. As set on the devices
Framing	Modbus RTU	Modbus ASCII with 8 or 7 data bits. ASCII is most often 7 data bits, even parity, 1 stop bit; 7 bits with no parity needs 2 stop bits
Answer within, retries, gap	1000 ms, 1, 0 ms	how long a device has to answer, how often a request is tried again, and extra time between requests
A device that fails	3 times in a row, tried again every 10 s	is answered for with exception 0B at once, without waiting on the bus, until it answers again
This gateway's unit ID	255	this ID, and 0, are answered by the gateway itself
Routes	unit 1–247 → the same address	four ranges of unit IDs, each mapped to RTU address = unit + offset
Exceptions	all three on	0A when no route matches, 0B when the device does not answer, 06 when the queue is full. Unticked: no answer, and the master times out by itself, which some masters prefer

Table 19: RS-485 settings

Changing the line of a bus already working. New line settings take effect after the gateway has answered the request that set them. Change the devices first, then the gateway.

10.2 As a gateway

A Modbus TCP master addresses a device on the bus by unit ID; the routes turn the unit ID into the RTU address. Each master has one request on the bus at a time, and the requests of several masters take turns. A device's answer, or its exception, goes back to the master unchanged.

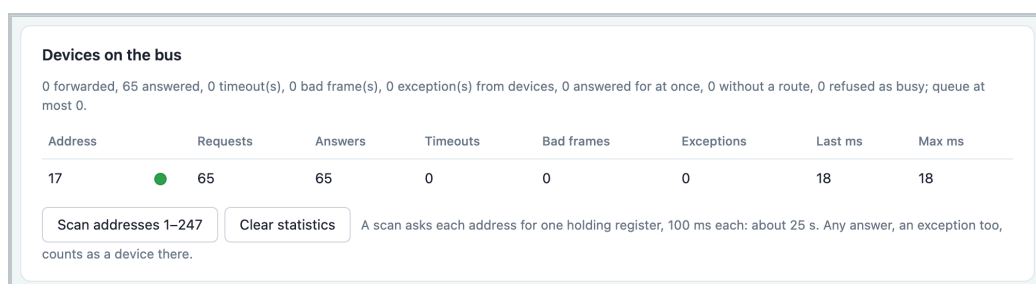


Figure 18: RS-485: devices on the bus

Devices on the bus lists every address that has answered, with its requests, answers, timeouts, bad frames and exceptions, and the last and longest answer time. *Scan addresses 1–255* asks each address for one holding register and, where that gets no answer, for its first eight coils — some relay boards answer nothing else — 100 ms each: up to about a minute. Any answer, an exception too, counts as a device there; an address that no longer answers leaves the list. A device at 255 is the last one the scan reaches.

10.3 Polling and the cache

Polling and cache

Cache

answer a read from memory when the data is at most ms old 0: off
 Several masters reading the same registers then cost the bus one read. Only a read wholly inside one earlier answer counts; a write through the gateway to that device drops what it covers, and a function the gateway does not know drops everything from that device.

Polled data

answered from memory until s old 0: three poll intervals
 Also while the device fails, so one lost poll does not look like a lost device. After that a read goes to the bus as usual, and gets 0x0B if the device does not answer.

#	Address	Read	From	Count	Every (s)	Data age	Polls	Failures
1	17	04 input registers	0	4	1.0	0.6 s	71	0
2	0	03 holding registers	0	0	0.0			
3	0	03 holding registers	0	0	0.0			

Gateway mode only. Address 0: entry unused. Up to 125 registers or 2000 bits per entry. A master's request always goes first; polling uses the time the bus is free. Register numbers from 0.

0 read(s) answered from memory, 0 went to the bus; 71 poll(s), 0 failed; 0 dropped by writes; bus busy 2 % of the last 10 s.

Figure 19: RS-485: polling and the cache

- Cache.** When several masters read the same registers, the bus is asked once: a read wholly inside an earlier answer that is no older than the set time is answered from memory. A write through the gateway drops what it covers. 0 turns the cache off.
- Poll list.** Up to 16 ranges that the gateway reads by itself, every set interval, when the bus is free; a master's request always goes first. Each entry gives the address, the read function (01 to 04), the first register or bit, the count (up to 125 registers or 2000 bits) and the interval in seconds. The table shows the age of the data, the polls and the failures.
- Polled data** is answered from memory until it is older than the set time (0: three poll intervals), also while a device fails, so one lost poll does not look like a lost device. After that a read goes to the bus as usual, and gets 0B if the device does not answer.

10.4 Testing a device

Test a device

Request

address 03 read holding registers from count / value

Answer

—

Gateway mode only. Goes out on the bus as any master's request would, through the same queue and with the same timeout and retries. Register numbers from 0.

Figure 20: RS-485: test a device

Sends one request on the bus, as a master's request would go: through the same queue, with the same timeout and retries. Register numbers start from 0.

Traffic					
Ago	Address	Function	Result	ms	Bytes out/in
0.6 s	17	4	ok	18	5/10
1.5 s	17	4	ok	18	5/10
2.5 s	17	4	ok	18	5/10
3.6 s	17	4	ok	18	5/10
4.6 s	17	4	ok	17	5/10
5.6 s	17	4	ok	17	5/10
6.6 s	17	4	ok	18	5/10
7.7 s	17	4	ok	18	5/10

Figure 21: RS-485: the traffic, last transactions first

Traffic lists the last 32 transactions: how long ago, the address, the function, the result, the time taken and the bytes out and in.

10.5 As a device

A PLC or HMI on the bus reads and writes this gateway at the address set on the page, with the same registers as over Modbus TCP: the battery-free devices, the terminals and the gateway's state. The same write ticks apply (9.1), whether Modbus TCP is on or not. A broadcast (address 0) is carried out and never answered.

10.6 Changing the address of a device

Every device on one bus needs its own address, and many leave the factory at 1 (or 255). Modbus does not say how an address is changed, and makers differ, so *ID* on a device's row of *Devices on the bus* opens a form that asks how:

Devices on the bus
3 forwarded, 18 answered, 0 timeout(s), 0 bad frame(s), 0 exception(s) from devices, 0 answered for at once, 0 without a route, 0 refused as busy; queue at most 0.

Address		Requests	Answers	Timeouts	Bad frames	Exceptions	Last ms	Max ms	
1		18	18	0	0	0	16	19	ID

A scan asks each address for one holding register, and one that stays silent for its first eight coils (some relay boards answer nothing else), 100 ms each: up to about 50 s. Any answer, an exception too, counts as a device there.

Change the address of the device at 1
Device type

Present address

New address 1-247

How ☐ as a broadcast (address 0)

Checked first: the new address must be 1-247, not already answering on the bus and not this gateway's own unit ID; a broadcast changes **every** device that listens, so it is refused while more than one answers. **Afterwards: disconnect the device's power for a few seconds, reconnect it, then scan the bus again** — many devices take a new address only after a restart.

Figure 22: RS-485: changing the address of a device on the bus

Addressing method	How the gateway changes the address
Address kept in holding register 0x0101	function 06, register 0x0101, sent to the present address
Address kept in holding register 0x4000	function 06, register 0x4000, sent to the present address
Relay boards set by a broadcast	function 16, register 0x0000, sent as a broadcast (address 0)
Other (from the device's manual)	the function, register and broadcast as set in the form

Table 20: Changing a device's address

The gateway checks first and refuses: a new address outside 1–247 (0 is the broadcast, 248–255 are reserved); one at which a device already answers; this gateway's own unit ID; and a broadcast while more than one device answers, because a broadcast changes every device that listens — disconnect the others first. It warns when no route reaches the new address.

Afterwards disconnect the device's power for a few seconds, reconnect it, and scan the bus again: many devices take a new address only after a restart. The old address leaves the list.

10.7 A device at address 255

Some modules leave the factory at address 255, outside the standard range 1–247 and the same as this gateway's own unit ID. To reach one, give the gateway another unit ID and add a route that reaches 255:

This gateway's unit ID and 0: answered here, not forwarded

Routes

unit	1	to	247	→ address = unit +	0
unit	255	to	255	→ address = unit +	0
unit	0	to	0	→ address = unit +	0
unit	0	to	0	→ address = unit +	0

Unit IDs in a range go to RTU address unit + offset (1–255). 0 in the first box: route unused. The default sends 1–247 to the same address. **A device still at address 255** (some modules ship that way): give this gateway another unit ID above, e.g. 254, and a route that reaches 255, e.g. unit 255 to 255; then set the device's own address.

Figure 23: RS-485: unit ID 254 and a route for unit 255

Then set the device's own address (10.6) to one in 1–247, and put the unit ID back to 255 and the route away if you like.

Terminal I/O

The I/O page shows the terminal block as it is seen from the front, Ethernet port below, with the names printed on the case label. Every terminal is named by its label and number in this manual, on the page and in the registers.



Figure 24: I/O: the terminal block

Terminals	What they are
01, 03, 05, 07 — DO-S1 to DO-S4	digital outputs: open collector, sinking to 09 DO-GND, for 24 V relays and indicators
13, 15 — DIN-S1, DIN-S2	digital inputs, 12/24 V DC, either polarity, common 11 DIN-SS
14, 16 — AVIN-S1, AVIN-S2	analog inputs, 0–10 V, against 12 ADC-GND
10, 08 — AVOUT-S1, AVOUT-S2	analog outputs, 0–10 V
17, 18 — VOUT-24V, P-GND	24 V field output and its return
19, 20 — EXT-VIN, EXT-GND	DC supply input, 14–32 V, when PoE+ is not used
02, 04, 06	RS-485 (chapter 10)

Table 21: Terminals. Electrical ratings are in the Hardware Specification

11.1 Terminals now

Terminals now	
DIN-S1 (13)	● on - 11 rising, 10 falling, 0 per minute
DIN-S2 (15)	● on - 10 rising, 9 falling, 0 per minute
DO-S1 (01)	● off - switched on 6 times, by its switch 10 times
DO-S2 (03)	● off - switched on 8 times
DO-S3 (05)	● on - switched on 5 times
DO-S4 (07)	● on - switched on 5 times
AVIN-S1 (14)	2.99 V → scaled 2990 ok
AVIN-S2 (16)	6.93 V → scaled 6935 ok
AVOUT-S1 (10)	3.00 V
AVOUT-S2 (08)	7.00 V

Figure 25: I/O: the terminals now

Each digital input with its rising and falling edges and the rising edges in the last whole minute; each digital output with the times it was switched on; the analog inputs in volts and scaled; the analog outputs as set; and the supply. The page follows the terminals while it is open.

11.2 Setting the outputs

Set the outputs

Digital outputs

DO-S1 (01)

On

Off

DO-S2 (03)

On

Off

DO-S3 (05)

On

Off

DO-S4 (07)

On

Off

Open collector, sinking to DO GND, for 24 V relays and indicators.

AVOUT-S1 (10)

V

Set

0 to 10 V

AVOUT-S2 (08)

V

Set

0 to 10 V

Input counters

Clear both

Kept across a restart; saved to flash at most every ten minutes.

Figure 26: I/O: setting the outputs

The page switches each digital output on or off and sets each analog output from 0 to 10 V. A master does the same with coils 0–3 or holding register 100 (the four outputs as bits) and holding registers 101–102 (millivolts), when *allow a master to set the outputs* is ticked. The input counters are kept across a restart and cleared here, or over Modbus.

11.3 At start and when the master goes quiet

At start and when the master goes quiet

Digital outputs at start ☐ DO-S1 (01) ☐ DO-S2 (03) ☐ DO-S3 (05) ☐ DO-S4 (07)
Off unless ticked. From power-on until the application starts (under a second) the outputs are held off.

Analog outputs at start AVOUT-S1 (10) 0.00 V AVOUT-S2 (08) 0.00 V

Master gone quiet after 0 s without a Modbus request (0: never)
☐ digital outputs go to: ☐ DO-S1 (01) ☐ DO-S2 (03) ☐ DO-S3 (05) ☐ DO-S4 (07)
☐ AVOUT-S1 (10) goes to 0.00 V ☐ AVOUT-S2 (08) goes to 0.00 V
 Counted from the last request a master made after the gateway started, so a restart alone never trips it. The outputs stay at their safe values until something sets them again.

Pulse DO-S1 (01) 0 DO-S2 (03) 0 DO-S3 (05) 0 DO-S4 (07) 0 ms
0: an output stays on until switched off. Otherwise it switches itself off after this long, whatever turned it on.

Analog output model
 AVOUT-S1 (10): full scale 12.21 V, k 2.045, delay -3.30 %
 AVOUT-S2 (08): full scale 12.20 V, k 2.055, delay -3.60 %
 The output is not proportional to the PWM: $V = F \cdot e / (e + k \cdot (1 - e))$, $e = d - \text{delay}$. Defaults were fitted to meter readings on one unit, per output (within 0.4 % from 2 to 10 V there). The delay differs a little between units: below about 1 V, calibrate each unit. To fine-tune, set two outputs, measure them at the terminal against ADC-GND (12), and adjust.

Save

Figure 27: I/O: at start and when the master goes quiet

- **At start.** Which digital outputs come on, and the analog outputs' values. Until the firmware starts, under a second after power-up, the outputs are held off.
- **Master gone quiet.** After a set time with no Modbus request (0: never), the outputs go to their safe values: the digital outputs to the ticked state, each analog output to its value. The time counts from the last request a master made after the gateway started, so a restart alone never trips it. The outputs stay at their safe values until something sets them again.
- **Pulse.** A digital output switched on goes off by itself after the set time; 0 stays on.
- **Analog output model.** The output voltage is not proportional to the drive; the defaults were fitted to meter readings and are close on every unit. To fine-tune one, set two outputs, measure them at the terminal against 12 ADC-GND, and adjust.

11.4 Inputs

Inputs

Debounce DIN-S1 (13) 20 DIN-S2 (15) 20 ms
How long a new level must hold before it counts. 12/24 V DC, either polarity.

AVIN-S1 (14) 0-10 V
 scale 0 - 10000 mV or μ A to 0 - 10000
☐ high alarm above 0 ☐ low alarm below 0 hysteresis 0

AVIN-S2 (16) 0-10 V
 scale 0 - 10000 mV or μ A to 0 - 10000
☐ high alarm above 0 ☐ low alarm below 0 hysteresis 0

Averaging 8 samples, 25 ms apart
 The scaled value is what the terminal reads, mapped linearly: for a 4-20 mA sensor of 0-100.0 °C, scale 4000 - 20000 to 0 - 1000. Alarms are in scaled units.

Save

Figure 28: I/O: inputs

- **Debounce.** How long a new level must hold on a digital input before it counts.

- **Analog inputs.** Volts, or 4–20 mA where the input is fitted for current. The scaled value is the terminal reading mapped linearly: for a 4–20 mA sensor of 0–100.0 °C, scale 4000–20000 to 0–1000.
- **Alarms.** A high and a low alarm, in scaled units, with hysteresis: a high alarm clears only once the value has fallen below the alarm minus the hysteresis, and a low alarm the other way round. The alarms appear on the page, in the input registers and as discrete inputs, and each one raised is counted.
- **Averaging.** Samples 25 ms apart.

11.5 Switches that work the outputs

The screenshot shows a configuration window titled "Switches that work the outputs". It contains four rows, each representing a digital output (DO-S1, DO-S2, DO-S3, DO-S4). Each row has a dropdown menu for the switch action (e.g., "a press toggles it", "nothing"), a dropdown menu for the switch ID (e.g., "e21500092da6", "none"), and a set of checkboxes for on/off contacts (A0, A1, B0, B1) and an "or input" dropdown menu (DIN-S1 (13)).

Figure 29: I/O: switches that work the outputs

A battery-free switch can work a digital output directly, with no PLC and no network in the path. Choose the switch and what it does:

Choice	The output
a press toggles it	changes over on each press of the <i>on</i> contacts
on and off contacts	comes on with a press of an <i>on</i> contact and goes off with a press of an <i>off</i> contact
on while held	on while an <i>on</i> contact is held down, off when it is let go
on while occupied	follows an EMDCB occupancy sensor: on while occupied, off when vacant
on while the magnet contact is closed / open	follows an STM 550B's magnet contact
follows a digital input	copies DIN-S1 or DIN-S2

Table 22: What a switch or sensor does to an output

The *Rules* tab (11.6) does all this and more, for the terminals and for relays on the bus.

Only a switch that the forwarding policy lets through works an output (7.4): a switch on the block list, or not on the allow list, is heard but changes nothing. A single-rocker switch has only two of the four contacts; tick the ones it has.

11.6 Rules

The *Rules* tab sets what battery-free switches and sensors do — to this gateway's terminals and to relays on the RS-485 bus, with no PLC, no master and no network in the path. Up to 64 rules, for up to 48 switches and sensors (the device list, 7.5); each rule names one device and its kind, gives each of its events an effect, and ticks the outputs it works. Several rules may use one switch.

Rules

Rule 1 Magnet contact (STM 550B) device e50010002fa8 ☐ only while armed

closed on

open off

not heard for 0 min — 0 minutes: never

on for a time: 0 s

This gateway ☐ DO-S1 (01) ☐ DO-S2 (03) ☐ DO-S3 (05) ☐ DO-S4 (07)

Bus 1 ☒ Ch 1 ☐ Ch 2 ☐ Ch 3 ☐ Ch 4 ☐ Ch 5 ☐ Ch 6 ☐ Ch 7 ☐ Ch 8

7 event(s) with an effect, 7 write(s), 7 done, 0 failed; last written off; heard 27 s ago

Figure 30: Rules: a magnet contact works channel 1 of the relay board at address 1

Kind	Events
Switch	A0, A1, B0, B1 — each pressed and released (A0 A1 on one rocker, B0 B1 on the other)
Occupancy sensor (EMDCB)	occupied, vacant
Magnet contact (STM 550B)	closed, open
every kind	not heard for the minutes given (0: never)

Table 23: The kinds of device and their events

Effect	What the outputs do
—	nothing
on / off	on, or off
toggle	turn over, from what the first of them was last written — by any rule
restore	go back to what they were before this rule last changed them, unless another rule has changed them since
on for a time	on, then off after the seconds given (whole seconds; it may run up to a second longer)
arm / disarm	the outputs stay as they are; the armed state (11.7) changes

Table 24: Effects

The outputs are ticked in a grid: this gateway's DO-S1...S4, and channels of each address on the bus (channel n is coil $n-1$, written with function 05; outputs on the bus need the port as a gateway). Eight channels show per address; for a 16- or 32-channel relay module, enter its address and channel count under the grid (up to 256). Up to 16 outputs per rule, on as many devices as you like.

11.7 Arming

Armed

Disarmed

Rules marked "only while armed" act only while armed. Arm and disarm here, with a switch (effects *arm* and *disarm*), or over Modbus (holding register 500: 1 armed, 0 disarmed). The state survives a restart.

Figure 31: Rules: the armed state

A rule ticked *only while armed* does nothing while the gateway is disarmed. Arm and disarm on this card, with a switch (effects *arm* and *disarm*), or over Modbus (holding register 500: 1 armed, 0 disarmed, with the settings write tick). The state survives a restart. A SCADA or PLC can also read each rule's state over Modbus and acknowledge the rules that have fired (System Integration Guide).

Rule 3 Magnet contact (STM 550B) device: e50010002fa8 ☒ only while armed

closed

open

not heard for: 0 min 0 minutes: never

on for a time: 10 s

This gateway ☐ DO-S1 (01) ☐ DO-S2 (03) ☐ DO-S3 (05) ☐ DO-S4 (07)

Bus 1 ☒ Ch 1 ☐ Ch 2 ☐ Ch 3 ☐ Ch 4 ☐ Ch 5 ☐ Ch 6 ☐ Ch 7 ☐ Ch 8

0 event(s) with an effect, 0 write(s), 0 done, 0 failed; last written off; heard 29 s ago

bus address channels 8

Figure 32: Rules: only while armed, a door opened turns a siren on for 10 s

11.8 How rules work

1. **Several rules may work the same output** — a magnet contact and a switch, say. The latest event decides.
2. **A sensor counts when its state changes**, not on every report it sends.
3. **Not heard** fires once when the device has sent nothing for the minutes given, and again only after it has been heard. It suits sensors, which report on their own: a battery-free sensor in the dark, or out of range, falls silent, and this is how you find out. A battery-free switch sends only when pressed, so its silence means nothing. Watch how often each sensor reports where it is fitted before choosing the minutes.
4. **Only while armed**: such a rule does nothing while disarmed; arm and disarm still work.
5. **Who is listened to**: only a device the forwarding policy lets through (7.4), and only a telegram newer than the last one taken — one recorded and played back does nothing.
6. The terminals keep working with the network down.

Use	Rule
Push button	switch: B0 pressed → on, B0 released → off
Light switch	switch: B0 pressed → on, B1 pressed → off; or B0 pressed → toggle
Meeting room	occupancy: occupied → on, vacant → restore — a light switched on by hand stays on
Door alert	magnet contact: open → on, closed → restore
Intrusion alert	each sensor: occupied / open → on for a time (180 s), only while armed; not heard for 60 min → on. A switch: B0 pressed → arm, B1 pressed → disarm

Table 25: Examples

An alert, not a certified alarm system. A telegram can be missed (radio), the 2.4 GHz band can be jammed, and the gateway is not approved as an intruder or safety alarm: do not rely on it where life or property depends on it. Telegrams are not checked for a signature: arm and disarm from the page or over Modbus where that matters, not with a battery-free switch.

11.9 Wiring examples

Rules work relay modules on the RS-485 bus and this gateway's own digital outputs; what those switch is wired as below. No maker is named: take each device's terminals from its own manual. The roller-blind examples have not been tried with a motor here.

The RS-485 bus. One cable from device to device, + and – on a twisted pair, 06 to the devices' ground. Makers label the two lines differently (A / B, + / –): if a device does not answer, swap them at that device. The gateway's end is terminated; fit 120 Ω across + and – at the far end only. Every device needs its own address (10.6).

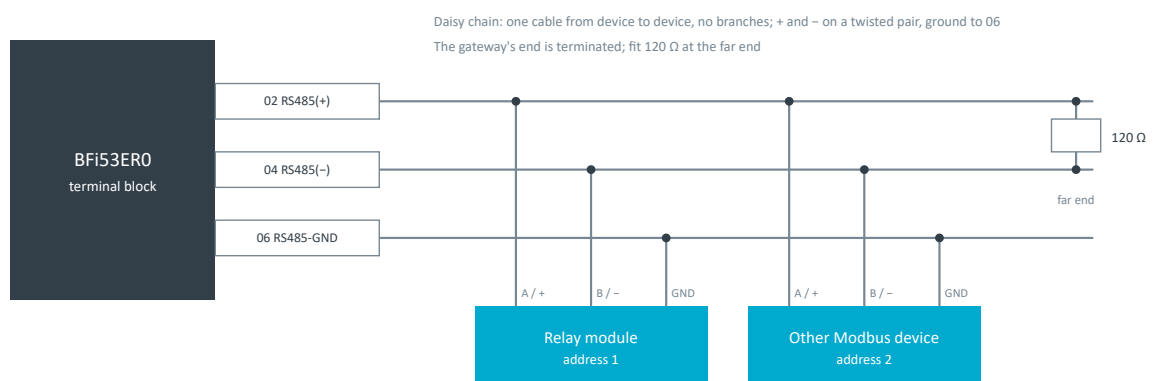


Figure 33: Wiring: the RS-485 bus

A dry-contact roller blind (up / stop / down). The motor's own controller keeps the limits and the interlock; the gateway only presses its buttons. Three relay channels: their commons to the motor's COM, their normally open contacts to UP, STOP and DOWN.

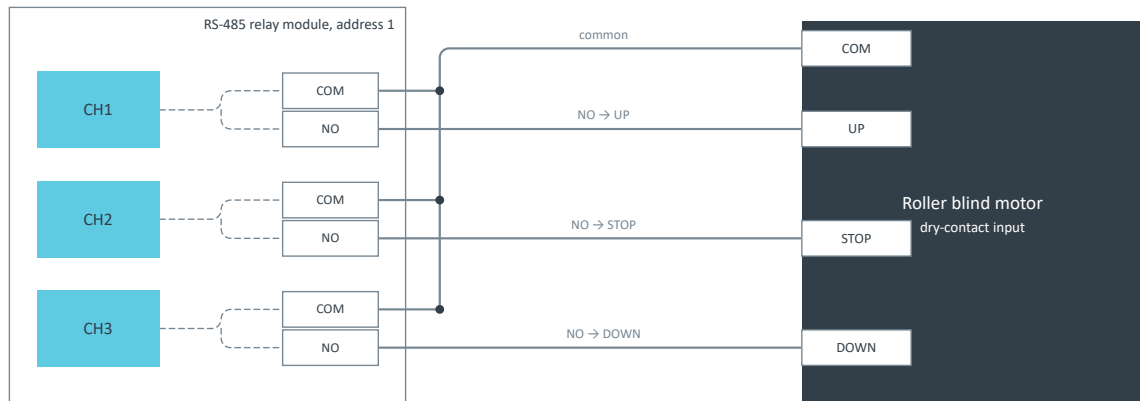


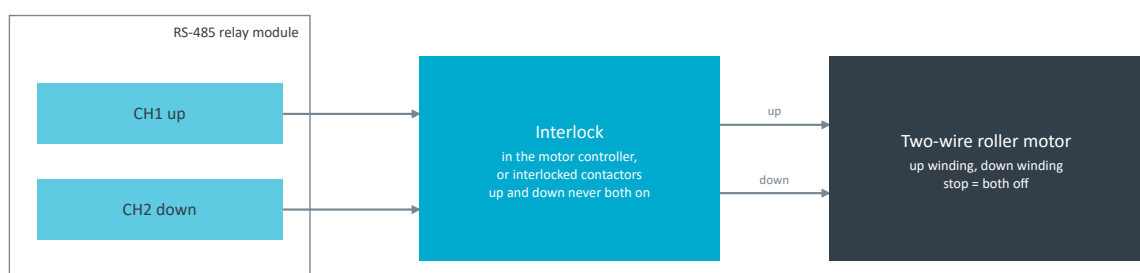
Figure 34: Wiring a dry-contact roller blind on three relay channels

Rule	Effects (device: one switch)	Output
1	A0 pressed → on; A0 released → off	relay module, channel 1 (up)
2	B0 pressed → on; B0 released → off	channel 2 (stop)
3	A1 pressed → on; A1 released → off	channel 3 (down)

Table 26: Rules for a dry-contact roller blind

Each contact closes for as long as its button is held, as the wall switch the motor expects: short and long presses, and holding STOP for a favourite position where the motor has one, reach the motor unchanged. *On for a time* counts whole seconds and may run up to a second longer: use it for up and down only, never for STOP. Several motors on one set of contacts, where their maker allows it, move as one group; one rule with up to 16 outputs makes an all-up or all-down button. With 64 rules a gateway takes up to 21 such blinds, or 20 and one all-up / all-stop / all-down set.

A two-wire roller motor (up / down; stop = both off). Two relay channels, up and down, through an interlock — in the motor's controller, or interlocked contactors — so that up and down are never on together.



Mains wiring by a qualified electrician, to the motor maker's diagram

Figure 35: Wiring a two-wire roller motor behind an interlock

Rule	Effects (device: one switch)	Output
1	A0 pressed → on; A1 pressed → off; B0 pressed → off	channel 1 (up)
2	A1 pressed → on; A0 pressed → off; B0 pressed → off	channel 2 (down)

Table 27: Rules for a two-wire roller motor

The gateway is not an interlock. It writes the outputs one after another, tens of milliseconds apart, and a write can fail. Up and down must be locked against each other in the wiring or the motor controller. Mains wiring by a qualified electrician, to the motor maker's diagram.

A digital output and a 24 V relay. DO-S1...S4 are open collector, sinking: each switches the low side of a 24 V relay coil. Feed the coil from 17 VOUT-24V and tie 09 DO-GND to 18 P-GND, or use an external 24 V supply with its 0 V on 09. Use relays with a suppression diode across the coil, as most PLC interface relays have. The coil is the Class 2 load; what the relay's contacts switch is outside the gateway's circuit and follows the relay's rating and the electrical code. The contacts are then a dry contact for a load or a motor input: three outputs make one dry-contact blind (up, stop, down) without a bus. Never wire a motor's dry-contact input to DO-S1...S4 directly.

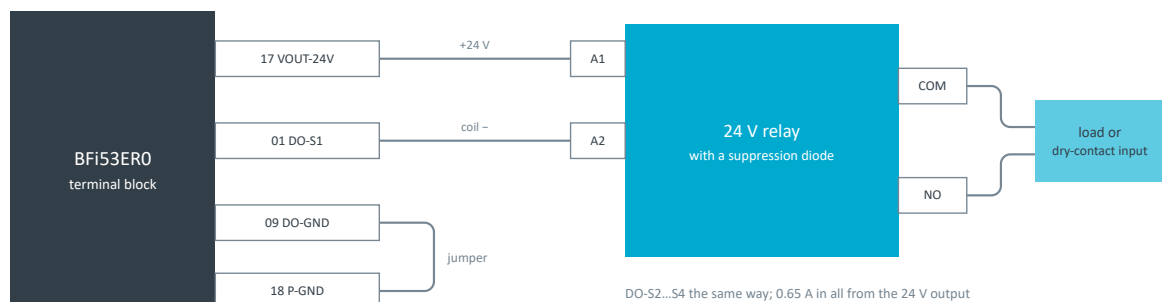


Figure 36: Wiring: a digital output switching a 24 V relay

11.10 After a power cut

What each output does when power comes back is set on the *Rules* tab, card *After a power cut*. The *Relay modules* list gives each RTU address one line — its number of channels, their state at power-up and the order in which it is put back — so that a 16-channel board needs one line, not sixteen. *Outputs* lists every output a rule works and every channel with a state of its own, with what it is now; a channel follows its module unless it is given its own state.

After a power cut

Relay modules

Module	Channels	At power-up	Order	Now
Bus 1	8	on	first	reads back as written; one write for all channels

bus address Add a module

Outputs

Output	Now	At power-up
Bus 1, Ch 1	on	as before the power cut

Save

When the gateway starts, and when a device on the bus answers again, outputs are set as chosen here: a channel's own state, else its module's. Modules are put back in their order, first to last, 0.2 s apart; a module's channels in one write (function 15) where it takes one, else one by one. An output a rule pulses (on for a time) or holds (a switch's release does something) is always switched off. The gateway reads the bus outputs back every 10 s, or less often so as to use at most a tenth of the bus: an output kept on that a device lost by restarting is put back, and a pulsed one found on is switched off — on devices whose coils read back as written. "As before" is kept for each module's first 64 channels. Set relay modules that can choose their own power-up state to off.

Figure 37: Rules: relay modules and outputs after a power cut

State at power-up	What the gateway does
as the module (a bus output's default)	the state of its module's line; with no line, leave it
leave as it is	writes nothing: the output keeps what its device does at power-up
off / on	switches it off, or on
as before the power cut	puts back the state it had; the gateway keeps it 5 s after each change
off — a rule pulses or holds it	fixed: an output used by <i>on for a time</i> , or by a switch whose release does something, is always switched off, so that a restart never leaves such a contact closed
terminals DO-S1...S4	as set on the I/O page (<i>at start</i> , 11.3), or as before the power cut

Table 28: States at power-up

- **When.** When the gateway starts — the terminals at once, the bus outputs about 3 s later — and whenever a device on the bus answers again after not answering, such as a relay module that lost power alone.
- **In order.** Modules are put back in their order — first, normal, later, last — 0.2 s apart, so that loads do not all start together: lighting first, say, and pumps last. A module's channels go in one write (function 15) where the module takes one, else one by one, 0.2 s apart.
- **Read-back.** Every 10 s — less often when there are so many devices that it would take more than a tenth of the bus — the gateway reads the coils of each device it works (function 01, eight at a time). On a device whose coils read back as written, it learns what the outputs are (so a toggle starts from the right state), puts back an output kept on that the device lost by restarting, and switches off a pulsed output found on. A device that does not read back what was written is given its power-up states only. Coils that a Modbus master writes through the gateway are followed too.
- **Sensors.** A rule acts on the first report a sensor sends after the gateway starts, so outputs that follow a sensor take its present state.

Use	State at power-up
Dry-contact roller blind, door or motor button contacts	off (fixed, as they are pulsed or held)
Sirens and buzzers	off
Heaters, pumps and other loads with a risk	off
Lights and ordinary loads	as before the power cut
The few that must be on (ventilation, safety lighting)	on

Table 29: Suggested states at power-up

Relay modules. Where a relay module can choose its own power-up state, set it to off and let the gateway decide. *As before* is kept for the first 64 channels of each module, for up to 32 modules.

Time and history

12.1 Time

The screenshot shows a web interface for configuring the system's time. At the top, it displays the current time: '10/1/2026, 12:29:37 AM from a browser, set 42 min ago'. Below this, it states 'Start #22, running 47 min. Every record on the card carries the start number and the time since that start, so records sort even before the time is known.' The 'Time server' section has a checkbox labeled 'ask' which is checked, followed by a text input field containing 'pool.ntp.org' and a button labeled 'not asked yet'. Below this, there is explanatory text about SNTP and Modbus master time setting. At the bottom, there are two buttons: 'Save' and 'Set from this computer now'.

Figure 38: System: Time

The gateway has no battery-backed clock. It learns the time from one of three sources:

Source	How
a time server	SNTP, at start and every hour. A site without internet can name its own server, by name or address
a Modbus master	writes holding registers 400–401, Unix seconds
a browser	signing in sets it, and <i>Set from this computer now</i>

Table 30: Where the time comes from

A time server's time is kept over the others for a day. Every start is numbered, so records sort correctly even before the time is known. Telegrams sent over UDP and TCP still carry no time of day: the receiver stamps them.

12.2 History on the microSD card

The screenshot shows a web interface for configuring history recording on a microSD card. It starts with the title 'History on the microSD card'. Below, it says 'Now recording — 1 file(s), about 95 KB of 8 MB; 229 line(s) this start'. A paragraph explains that polled RS-485 registers, terminals, and analogue inputs are recorded at specific intervals. It also mentions that one CSV spreadsheet is opened, with each line containing start number, time since start, and device status. The oldest record is deleted when the newest is written, with a maximum of 8 MB. The 'Record' section has a checkbox labeled 'on' which is checked, followed by 'registers at least every' and a text input field with '60', and 's (0: only on a change), analogue inputs every' and another text input field with '60'. At the bottom, there are four buttons: 'Save', 'Download the newest (up to 256 KB)', 'Download all', and 'Clear'.

Figure 39: System: History on the microSD card

With a card fitted, the gateway records, as one CSV file a spreadsheet opens:

- the RS-485 registers it polls (10.3), when a value changes and at least every set interval;
- the terminals: a digital change at once, the analog inputs every set interval;

- events: a start, the time set, a device that stops or resumes answering, settings saved.

Every line carries the start number and the time since that start, and the time of day in UTC once it is known. The oldest is deleted as the newest is written: 8 MB at most. *Download the newest* gives up to 256 KB, *Download all* the whole record, and *Clear* starts again.

Compatible devices

Battery-free switches and sensors take their energy from a press, from light or from motion. The gateway receives those that send over Bluetooth LE in EnOcean's format.

Bluetooth only. The gateway listens at 2.4 GHz. Battery-free products that use the 868, 902 or 928 MHz bands are a different radio and are not received.

13.1 BANFi battery-free switches — BFi5EWSSB / BFi5EWSDB



BFi5EWSSB, single rocker



BFi5EWSDB, double rocker

BANFi's battery-free wireless switches: pressing the rocker makes the energy, and the switch sends its telegram over Bluetooth LE, with no wiring, no battery and no maintenance. 50 × 50 mm, white; fixed with an adhesive pad or a standard frame to glass, tile or partitions. The BFi53ER0-BF gateway receives them as switches, like the other compatible switches: the live view shows the contact pressed, the Modbus registers give the contact states and press counts, and a switch can work a terminal output directly (chapter 11).

Model	Rockers	Channels	For
BFi5EWSSB	single	2 (press / release)	one zone: on/off and dimming
BFi5EWSDB	double	4 (press / release)	two zones and scene selection

Table 31: BANFi battery-free switches

13.2 Compatible EnOcean models

The compatible models below, made by EnOcean, have been received and shown by the gateway.



Wall switches — PTM 215B / PTM 216B

Kinetic push-button transmitters: pressing the rocker makes the energy for the telegram. Single rocker (2 channels) or double rocker (4 channels); a press and a release each send a telegram. The PTM 216B is the same transmitter as a module, for switch makers.



Single-key switch — PTM 535BZ on ECO 260

One key with no contacts wired; the live view shows it as a switch with a single key.



Multisensor — STM 550B

Solar-powered: temperature, humidity, illuminance, acceleration and a magnet contact, sent on a schedule and on change.



Motion detector — EMDCB

Solar-powered ceiling-mount occupancy sensor with illuminance.

BFi5EWSSB / BFi5EWSDB photographs: BANFi Semiconductor Co., Ltd.; other device photographs: EnOcean GmbH product images.

Settings backup and restore

Under *System* → *Settings backup*. A backup is one file saved on your computer; a restore reads such a file, from this gateway or another, and lets you choose what to restore before anything changes.

Settings backup

Back up

Save settings to a file

Every setting except the password: the name; IPv4 mode, address, gateway and DNS; forwarding and the UDP output for IPv6 and for IPv4; Modbus TCP; I/O settings and switch bindings; the RS-485 gateway; device names, places, positions and lists; live-view heading, remote viewing, status light and the microSD update switch. IPv6 addresses are automatic and need no setting. The file is saved on this computer; it holds device names and places, so keep it as you would a site plan.

Restore

Choose File No file chosen

A file saved here, from this gateway or another one. You choose what to restore before anything changes.

Figure 40: System: Settings backup

14.1 What is in the file

Part	Settings
Name and network	the name; IPv4 mode, address, prefix, gateway and DNS. IPv6 addressing is automatic and needs no setting
Forwarding and output	forward on or off, which devices to forward, installation details; the UDP output for IPv6 and for IPv4 (on, destination, port)
Modbus	Modbus TCP on or off, its address family and the two write ticks; Modbus UDP; Modbus RTU over TCP and its port; the list of addresses that may ask
Terminals	the outputs at start and in the safe state, pulses, debounce, the analog-input modes, scaling and alarms, averaging, the analog-output model, and the switches that work the outputs. The outputs themselves are not restored
RS-485	what the port is, its address, line, framing, timing, routes and exceptions, the cache and the poll list
Time and history	the time server, and what the card records and how often
Devices	every device's name, place, latitude, longitude, height, allowed and blocked
Other	live-view heading, remote viewing, status-light brightness, the microSD update switch

Table 32: Contents of a backup

The password is never in the file, and a restore never changes it. The file does hold device names, places and coordinates, and where telegrams are sent: keep it as you would a site plan.

14.2 Backing up

1. Sign in and open *System*.

2. Under *Settings backup*, press **Save settings to a file**.
3. The browser saves `bfi53er0-xxxx-settings-date-time.json`, stamped with the computer's clock.

14.3 Restoring

1. Under *Settings backup*, choose the file next to **Restore**.
2. The page shows where and when the file was saved and the number of devices, and offers four parts, each with a tick:
 - forwarding and UDP output, with the file's IPv6 and IPv4 destinations; this part also restores the Modbus, terminal, RS-485, time and history settings;
 - devices, and whether to take off devices that are not in the file;
 - live-view heading, remote viewing, status light and microSD update switch;
 - name and IPv4 settings.
3. Press **Restore**. The page reports *Restored.*, or lists what could not be restored.
 - **A file from another gateway.** The name and IPv4 part is not ticked, and the page warns: two gateways must not answer to the same name or address. Tick it only when this gateway replaces the other.
 - **A changed IPv4 setting** runs on trial, as on the *Network* page (7.3): confirm it within 120 s.
 - **A changed name.** The page moves to the new name, where you sign in again.
 - **Checks.** Every value is checked by the gateway exactly as if it had been typed on its page. A file that is not a BFi53ER0 settings file, or comes from a newer firmware, is refused before anything changes.

Firmware update

Firmware is released as a signed image file. There are four ways to install it, and all four end the same way: the gateway restarts into the new image and runs it *on trial*. The image is kept only once it has been confirmed. An image that is never confirmed is replaced by the previous one at the next restart. Only images signed for this product run, however they arrive. While an image is being received the gateway keeps answering Modbus, with pauses of a few tens of milliseconds at most (9.5).

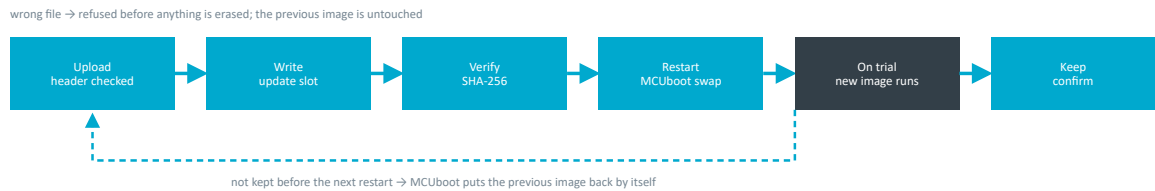


Figure 41: Every update: checked, written, verified, tried, kept

Way	Use it when	Kept by
Settings page, <i>System</i>	you can reach the gateway with a browser	reloading the page, then <i>Keep</i>
From a computer, <code>dfu.py</code>	a script or a fleet tool updates many gateways	the tool, after checking what came back
From a phone, Bluetooth	the network is not working	the settings page, or <code>dfu.py</code> confirm
microSD card, at start	nobody can reach the gateway over the network	itself, after 2 minutes working

Table 33: Update paths

15.1 From the settings page

1. Sign in and open *System*.
2. Under *Firmware* → *Update*, choose the signed image file and press **Upload and restart**. The light shows magenta while the image is written: do not remove power.
3. The gateway restarts; the page reloads by itself when it answers. The new firmware is shown as *on trial*.
4. Press **Keep** in the banner. To go back instead, restart the gateway before keeping it, or later use *Go back to ...*

A wrong file — the `.hex`, a truncated download, an image too large — is refused before anything is erased, with a message saying which.

15.2 From a computer

```
python3 dfu.py -d 'fe80::1a2b:3cff:fe4d:5e6f%en0' deploy <signed image> # the IPv6 address on the Network page
```

`dfu.py` is a single Python 3 file with no dependencies. It takes the gateway's IPv6 address, with the computer's interface after % for a link-local one. It uploads the image over UDP port 1337 (local network only), marks it for trial, restarts the gateway, waits for the new image to answer, checks that it is the one sent, and only then keeps it. It takes about 50 s. If the new image never answers, the gateway goes back to the previous one by itself.

15.3 From a phone over Bluetooth

1. On the settings page, *Bluetooth*, open Bluetooth for 10 minutes.
2. In nRF Device Manager, refresh the list and choose **BFI53ER0**.
3. Under *Image*, select the signed image file, leave *Erase Application Settings* off, and set *Number of buffers* to *Disabled*. With the app's default, the upload takes about half an hour.
4. Start, and choose **Test Only**.
5. Keep the new image on the settings page. Bluetooth is closed again after the restart, so the phone cannot keep it.

15.4 From the microSD card

Figure 42: System: Update from the microSD card

1. Copy the signed image to the card as the release notes describe.
2. Fit the card and restart the gateway with the Ethernet cable connected.
3. The light shows magenta and white by turns, fast, while the image is written (about 15 s), and the gateway restarts into it.
4. The new image runs on trial, the light magenta and white by turns, slowly. After 2 minutes with the radio, the watchdog and the network all working, it keeps itself.
5. The result is written to the card, in a file named after the gateway, and shown under *System*.

Rule	Why
Only a newer version is installed	a card never takes a gateway back to an older image; the same version is refused even as a different build
Each image is tried once	an image already running, or one that was tried and did not stay, is left alone however long the card stays in
The whole file is checked first	a damaged file, or one signed for another product, is refused before the image to go back to is erased
Application images only	a network-core image is refused
It can be switched off	under <i>System</i> , where people who should not update the gateway can reach the card slot

Table 34: Updates from the card

The results file is named after the gateway, so one card taken round several gateways comes back with each one's result.

Password, reset and recovery

16.1 The reset button

The reset button beside the microSD socket restarts the gateway. Pressed several times in a row — press, wait for the light to turn white, press again, each within 10 s of the last:

Presses	Result
1	a restart; nothing changes
3	the password goes back to <code>admin</code> , to be changed at the next sign-in; nothing else changes
10	factory defaults, as below; the gateway restarts once more by itself

Table 35: Reset button

The light breathes green quickly for 15 s when either has been done. A single press or a power cut never adds up to anything.

16.2 Recover with FLSEMI or BANFi

There is no universal password. On the sign-in page, *Recover with FLSEMI or BANFi* shows a one-time challenge. Send it to FLSEMI support through the password-recovery form at flsemi.us/downloads#recovery; FLSEMI sends back a code that resets the password to `admin`. The challenge stays valid for 72 hours, also across a restart.

16.3 Resetting settings

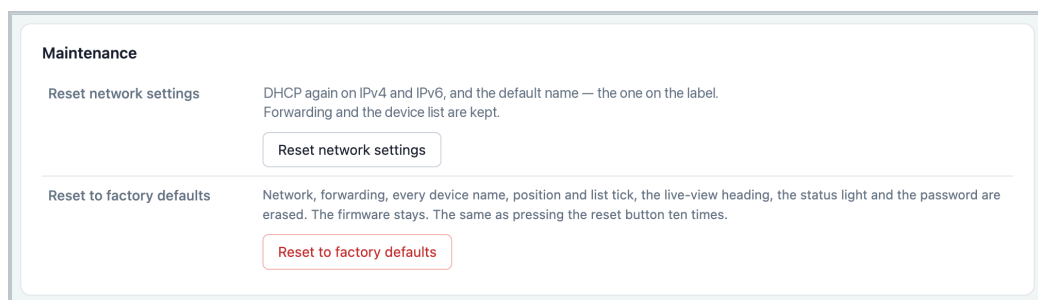


Figure 43: System: Maintenance

Reset	Erases	Keeps
Reset network settings	static address, gateway and the name: back to DHCP with link-local fallback, and the name on the label	forwarding, output, devices, password
Reset to factory defaults	everything the gateway stores: network, name, output, forwarding, devices, live-view heading, status light, remote viewing, the microSD update switch, password	the firmware

Table 36: Resets

Both are under *System* → *Maintenance*, and ask for confirmation. The gateway then restarts, and the page follows it to <http://bfi53er0-xxxx.local/>, reachable by name about 13 s later. While a new firmware is on trial, a reset is refused: the restart would put the old firmware back. Save a backup first (chapter 14) if the settings may be wanted again.

Troubleshooting

Symptom	Likely cause	Do
light stays red	no network address: no link	check the cable, and that the port supplies PoE+
light breathes amber	no microSD card, or the card failed: the recorder is off	nothing, if no recording is wanted; otherwise fit a FAT or exFAT card and restart
bfi53er0-xxxx.local does not open	the name was mistyped, the computer does not resolve .local names, or it is on another subnet	use the address the DHCP server gave the gateway; names work on the gateway's own segment only
the page opens, udp_receive.py prints nothing	the computer's firewall drops inbound UDP 9001	allow UDP 9001 for Python, or check with Wireshark, which sees packets before the firewall
some telegrams missing on a laptop on Wi-Fi	the access point drops broadcast and multicast	set a unicast destination (7.4), or read the TCP feed
a device never appears	out of range, or not a compatible Bluetooth device (chapter 13)	press it next to the gateway; 868 / 902 / 928 MHz products are not received
only some devices arrive	an allow list or block list is in force	<i>Forwarding → Which devices to forward</i>
settings pages answer 403	the request comes from outside the local network	use a computer on the gateway's network
sign-in locked	five wrong passwords	wait (30 s, doubling up to 15 minutes), or press the reset button three times
an update from the card does nothing	the image is not newer, was tried before, or card updates are switched off	read the result file on the card, or <i>System</i>
the light shows magenta and white slowly for a long time	an image from the card on trial, and no network	connect the network; the image keeps itself 2 minutes after it is working
a Modbus master cannot connect	Modbus TCP is off or limited to the other address family; the master is outside the local network, or not on the list of addresses; 32 masters are already connected	<i>Forwarding → Modbus TCP; Since the start counts what was refused</i>
a write is answered with exception 01	the tick for outputs or for settings is off, or the master's address is listed read only	tick it (9.1), or list the address read and write (9.4)

Symptom	Likely cause	Do
a device on the bus answers 0B	it did not answer in time: wiring, address, line settings or framing differ from the device's	<i>RS-485 → Test a device and Traffic; check that + and – are not swapped</i>
a unit ID answers 0A	no route covers it	<i>RS-485 → Routes</i>
an output switched by itself	the safe state: no Modbus request for the set time; or a switch working the output	<i>I/O → At start and when the master goes quiet; Switches that work the outputs</i>

Table 37: Troubleshooting

Specifications and notices

18.1 Performance

	Value
Devices tracked at once	256; when all are taken, the one heard longest ago gives up its place
Devices named, placed or listed	48
Telegram heard → sent on the network	about 46 ms on average: a telegram waits up to 60 ms for its own copies, so that copies is complete
Live view	updated the moment a telegram is heard
Settings page load	about 32 ms on the local network
Firmware update over the network	about 50 s, including the restart and the checks
Modbus TCP masters at once	32, sharing about 400 requests per second evenly
A Modbus read answered from the cache	about 2 ms, against about 43 ms through the bus at 9600 bit/s
RS-485 at 921600 bit/s	100 registers in about 7 ms
Modbus during a firmware update	longest pause 23 ms over the network, 36 ms from the settings page, 118 ms over Bluetooth
Analog outputs	within about ± 0.1 % of full scale, 0 to 10 V
Analog inputs	within about 0.8 % of full scale, 2 to 10 V

Table 38: Performance, measured on a bench gateway

18.2 Notices

Copyright. © 2026 BANFi Semiconductor Co., Ltd. and FL Semiconductor LLC, held jointly. The product is owned by BANFi Semiconductor Co., Ltd.

Product ownership. The BFi53ER0 / BFi53ER0S is a product of BANFi Semiconductor Co., Ltd. (Taiwan), which owns the product and its hardware design. FL Semiconductor LLC (FLSEMI) is the solution provider for the communication protocol stack and the firmware — the software running in the chip — and BANFi's point of contact in North America.

Patent pending. This product and the technologies it uses are covered by pending and published patent applications in the US, Taiwan and China.

Specifications are subject to change without notice. EnOcean is a trademark of EnOcean GmbH; Bluetooth is a trademark of Bluetooth SIG, Inc.; Nordic Semiconductor and nRF5340 are trademarks of Nordic Semiconductor ASA. All other trademarks belong to their owners.

18.3 Revision

Version	Date	Change
1.0	2026-09-29	First issue, for firmware 0.57.50
1.1	2026-09-30	Web edition: example names and addresses in the screenshots; no file names or card paths
1.2	2026-09-30	Firmware 0.57.51: the settings pages say "gateway"; screenshots retaken
2.0	2026-10-01	Firmware 0.57.82: Modbus TCP, UDP and RTU over TCP; RS-485; the terminals and switches that work them; time and history; screenshots retaken
2.1	2026-10-01	Copyright notice: held jointly by BANFi and FLSEMI; example code (6.3)
2.2	2026-10-01	Figure 1 shows Modbus TCP, Modbus RTU on RS-485 and the BFi53ER0 terminal I/O; BFi53ER0S terminal assignment to be announced
2.3	2026-10-02	Figure 1 redrawn in the Nordic Semiconductor product-specification style (orthogonal lines)
2.4	2026-10-02	Two screenshots: the supply row left out of the terminals card; the Modbus TCP help text shortened
2.5	2026-10-02	Compatible devices: BANFi battery-free switches BFi5EWSSB / BFi5EWSDB, with photographs; full part number BFi53ER0-BF stated
2.6	2026-10-02	Firmware 0.57.94: rules (11.6–11.8) — switches and sensors work the terminals and relays on the bus, arming; RS-485: devices at address 255 and changing a device's address (10.6, 10.7)
2.7	2026-10-02	Changing a device's address (10.6): the methods are described by function and register, without product names
2.8	2026-10-02	Firmware 0.57.97: up to 64 rules for up to 48 switches and sensors; wiring examples (11.9): the RS-485 bus, a dry-contact roller blind, a two-wire roller motor, a digital output with a 24 V relay; “not heard” is for sensors; more than eight channels per relay module; power and terminals: Listed Class 2 supplies and Class 2 loads only
2.9	2026-10-03	Firmware 0.57.98: after a power cut (11.10) — each output's state at power-up, the read-back of the bus outputs, suggested states
3.0	2026-10-03	Firmware 0.57.99: relay modules after a power cut (11.10) — one line per module, an order, one write per module
3.1	2026-10-03	11.10: wording of the Relay modules list
3.2	2026-10-03	Firmware 0.57.100: Recover with FLSEMI or BANFi (16.2); the sign-in screen retaken
3.3	2026-10-03	Firmware 0.57.102: the challenge is sent through a password-recovery form and stays valid for 72 hours, also across a restart (16.2)
3.4	2026-10-04	The FLSEMI edition for flsemi.us: password recovery through FLSEMI support and the form at flsemi.us/downloads#recovery (16.2); firmware 0.57.103
3.5	2026-10-04	The System Integration Guide is requested by leaving company details at flsemi.us/downloads#guide (1.1, 9.2)
3.6	2026-10-05	“Nordic Semiconductor” written in full

Table 39: Revision